SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, MAY 8, 1908

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION E—GEOLOGY AND GEOGRAPHY

IN spite of the fact that Section E held a summer field meeting[1] at Plattsburg, N. Y., during the week of July 3 last, the interest of its members in the winter meeting showed no abatement. A large number of its geological members attended the meeting of the Geological Society of America at Albuquerque, and consequently there was not a large attendance of those whose special interest is geology. But, on the other hand, the Association of American Geographers met in Chicago at the same time as Section E, and this attracted a large number of geographers, many of whom are members of the section.

Immediately after the general session of the association, the Association of American Geographers and Section E held a joint meeting for the purpose of arranging the program, after which the two organizations separated. The geological members of the section held six sessions in the Walker Museum, University of Chicago, during Tuesday, Wednesday and Thursday, with the vice-president of the section presiding, and the geographical members met with the American Geographers, except during the early portion of Wednesday afternoon, when the entire section met to listen to Professor Chamberlin's paper on the influence of the tides.

At the first meeting of the section Pro-

[1] An account of the summer meeting is printed in SCIENCE, No. 665, pp. 397–404, Sept. 27, 1907.

fessor W. S. Bayley was elected secretary of the section for the meeting in the absence of the regular secretary, Professor W. H. Hobbs was elected member of the general committee, Professor U. S. Grant, member of the council, and Mr. F. B. Taylor, member of the sectional committee for five years.

At the business meeting of the sectional committee held on Wednesday, January 1, Mr. Bailey Willis, of Washington, was nominated for vice-president of the association and chairman of the section, and Dr. F. P. Gulliver was named for secretary. At this same meeting also the names of about fifteen members were presented to the council with the recommendation that they be elected as fellows. Professor Charles R. Dryer was nominated as delegate from Section E to the Ninth International Geographic Congress, to be held at Geneva in July next.

Since the address of Vice-president Lane had already been read at the summer meeting of the section (Science, August 2, 1907, pp. 129–143) all of the sessions at Chicago were devoted to the presentation and discussion of papers, of which 31 were read in full. The abstracts of these follow:

The Red Sandstone Series of Southeastern Minnesota: C. W. Hall, Minneapolis, Minn.

Records of deep and artesian wells drilled in southeastern Minnesota for twenty years past have shown the existence of an apparently widely distributed sandstone beneath the overlying and non-aquiferous beds. Drillings to the granite rocks in several localities indicate a thickness of from 100 feet to 300 feet for this formation, and place it directly upon the basal granite rocks of this region. The paper correlated the scattered data with the view to establishing the existence of a well-defined sandstone series at this horizon.

Preliminary Account of the Geology of the Highlands of New Jersey: W. S. Bayley, Urbana, Ill.[2]

The Highlands of New Jersey are a part of the series of ridges of pre-Cambrian rocks that extend southwestward from the Hudson River to Reading in Pennsylvania. They have long been described as being composed of parallel layers of limestone and gneiss, and, principally, because of their association all of the rocks have been regarded as metamorphosed sediments. Recent observations have shown that the limestone is one member of a well-defined series of fragmental rocks of pre-Cambrian age, and that the gneisses are igneous rocks that have intruded these. The parallel arrangement of the rocks is due to the fact that the intrusive rocks invaded the old sedimentary series along their bedding planes. The structure of the gneiss is thought to be the result of flowage, by which some of their components have been strung out in line.

The complex gneisses and sedimentary rocks have been broken into blocks by great longitudinal faults, which almost invariably occur in the southeast sides of the gneiss ridges, separating them from the northwest sides of narrow longitudinal valleys underlain by Paleozoic rocks. One of the largest of these faults limits the Highland area on the south and separates it from the Piedmont plateau. Cross faults of comparatively small magnitude run nearly perpendicularly to the structure of the region and cause slight displacements in the interlaminated gneisses. They are of especial importance in connection with the magnetite mines, since they cause displacements of the ore bodies.

These generally consist of rich magnetic phases of the gneisses and like them are

[2] By permission of the director of the U. S. Geological Survey.

distributed in layers that generally strike and dip with the surrounding rocks.

The sedimentary rocks are correlated with the Grenville series of East Ontario and the Adirondacks.

Petroleum Fields of Illinois in 1907: H. FOSTER BAIN, director of the Illinois Geological Survey, Urbana, Ill.

The author declared that in 1907 Illinois will produce more than 24,000,000 barrels of crude petroleum. This is more than any state in the union, save California, produced in 1906 and in fact more than any country, save Russia and the United States. Production began here in June, 1905, with 5,489 barrels. The oil is of good grade, running about 32° Baume. It occurs in Carboniferous strata in Clark, Cumberland, Crawford and Lawrence counties. A number of different producing horizons have been recognized ranging from Upper Coal Measures down to the Chester group of the Mississippian. There is marked irregularity in pressure, in productivity and in relations to gas and salt water in the different pools, and it seems likely that final studies will lead to important conclusions regarding the genesis and accumulation of the oil.

General Petrology of Wisconsin Igneous Rocks: S. WEIDMAN, Madison, Wis.

This paper described the general chemical features of a large area of intrusive igneous rocks in central and northern Wisconsin. These were intruded as three separate or distinct magmas, as rhyolite, diorite-gabbro and granite-syenite. Phases of the granite-syenite magma are the highly interesting and rare rocks, nepheline-syenites and associated pegmatites. The several intrusive magmas are each characterized by relatively high alumina and low magnesia. The nepheline-syenites and associated quartz-syenites are especially characterized by high alumina and low magnesia and in them are developed such rare minerals as fayalite and hedenbergite as important rock constituents. Several unusual rock phases are developed. All the igneous rocks of the region show a close chemical relationship, and this close relationship is especially well illustrated in the chemical character of the minerals developed in the syenites and pegmatites.

Geology and Mining Industry of Chihuahua, Mexico: RUFUS M. BAGG, Jr., Urbana, Ill.

The author described briefly the main topographic features of the state of Chihuahua and explained their bearing upon the mineralization of the region.

The geologic formations were also discussed and the main types of ore deposits classified. Many examples of mines were cited to illustrate these types. The history of mine development and the future outlook of the mining industry in Chihuahua were discussed in conclusion.

Niagaran and Oriskanian in the Western Part of Virginia: E. B. BRANSON, Oberlin, Ohio. (Read by title.)

The Earthquake of 1872 in the Owens Valley, California: WILLARD D. JOHNSON, D. C., and W. H. HOBBS, Ann Arbor, Mich. (Read by W. H. Hobbs.)

This paper consisted principally of the description of a series of photographs and specially detailed maps of the country affected by the Owens Valley earthquake. The maps exhibited in an unusually fine manner the courses of recent faults in the valley and their general characteristics.

A Design for a Universal Seismograph with Duplex Recorders for Horizontal Motion: C. F. MARVIN, U. S. Weather Bureau, Washington, D. C.

The author described the construction of a single seismograph that will give every

detail of the horizontal components of earthquake motion.

The instrument is capable of producing no less than three distinct records of each component of horizontal motion, making six records in all; that is to say, two components of horizontal motion under high magnification (100 to 200, or more, if necessary); two other records of low magnification (1 to 10, if desired); and finally, during destructive or strongly-felt earthquakes, a low magnification record which will be inscribed on a rapidly-moving drum —thus realizing practically six separate records.

The construction of the instrument was shown by lantern slides.

Report of Seismological Committee of the International Seismological Association: H. F. Reid, Baltimore, Md., chairman. (Read by Dr. Otto Klotz, Ottawa, Canada.)

In the absence of Professor H. F. Reid, chairman of the seismological committee, Dr. Otto Klotz, of Canada, who with Dr. Reid attended the meeting of the International Seismological Association at The Hague in September last, read the chairman's report, of which the following is an abstract:

Twenty-two states are now members of the association, England, Austria and Canada having joined since last year. There were about fifty persons present either as delegates or as invited guests, and these included a majority of the leading seismologists of the world. Signor Palazzo, of Italy, was the retiring president. Professor A. Schuster, of Manchester, England, was elected president for the next four years. Professor Forel, of Switzerland, was elected vice-president for two years; and the next meeting of the permanent commission was fixed to take place in Switzerland two years hence; Strassburg was continued as the central bureau of the association for the next four years.

The report of the central bureau showed that it had made careful studies of seismological instruments at Strassburg during the last year, and that it had published the catalog of earthquakes for the year 1904.

In the competition for a cheap seismograph costing 300 Marks, and giving 40 to 50 magnification, instruments were exhibited by Professors Agemennone, Spindler and Boyer, of Göttingen, and Smitt, of Utrecht. They are to be sent to Strassburg and their relative efficiency carefully tested before the prize is awarded.

Many scientific papers were presented at the meeting of the association. Professor Weichert gave his conclusions regarding the character of the interior of the earth based on the result of seismological observations. They confirm his earlier idea of a central core of iron or steel surrounded by a stony layer, and establish the radius of the core at 4,500 kilometers, and the thickness of the stony layer at 1,500 kilometers. The existence of long vibrations of periods of eighteen seconds or more reveals, he thinks, the existence of a layer of liquid or plastic material at a depth of about 30 kilometers from the surface.

Prince Galitzin advocated the use of strong electro-magnetic damping and electro-magnetic recording appliances for seismographs.

A Reconstruction of the Water Planes of the Extinct Glacial Great Lakes in the Lake Michigan Basin: J. W. Goldthwait, Evanston, Ill.

In 1905 the writer made numerous measurements of altitude of the raised beaches on the west side of Lake Michigan by the aid of the Wye level. The definite correlation of several shore-lines below the "highest Algonquin" was thus made possible. Last summer similar data were se-

cured, under the direction of F. B. Taylor, on the east side of Lake Michigan, from the Straits of Mackinac southward and on the Upper Peninsula southward to Holland, Mich. From these data several distinct water planes of the extinct lakes, Algonquin and Nipissing, were recognized. They were shown in detail on a plotted profile. The inclined planes converge southward, and appear to coincide near Onekama, Mich., and Green Bay, Wis., to form a single horizontal water plane at the height of 596 feet A. T. or 15 feet above Lake Michigan.

The correspondence of this series of raised beaches with those studied and described by J. W. Spencer east of Lake Huron and Georgian Bay was discussed. The extension of the profile northward to the Sault Ste. Marie indicated a probable correlation between the raised beaches bordering Lake Michigan and those of the Superior Basin.

Earth Movements in the Laurentian Basin Since its Occupation by the Ice: WILLIAM HERBERT HOBBS, Ann Arbor, Mich.

The introduction of precise leveling to determine the present positions and altitudes of the abandoned shore lines within the Laurentian Basin, as indicated in the last paper, has opened a new era of study of the earth movements which have taken place within this province since the Pleistocene glaciation. Professor Hobbs's paper was a discussion of problems the solution of which was sought in field work undertaken for the Michigan Geological Survey during the season of 1907.

A Review of the Great Lakes History, with Special Reference to the Deformation of the Ancient Water Planes: FRANK B. TAYLOR, Fort Wayne, Ind.

South of the line passing through Lake St. Clair and Ashtabula, Ohio, the ancient beaches are substantially horizontal, and they are the same around the southern third of Lake Michigan, as shown by Professor Goldthwait. North of this, in the Lake Michigan Basin, the beaches above the Algonquin beach are all tilted upward towards the north; in the Lake Huron Basin they are tilted upwards towards the north-northeast, the rate being a foot to the mile or less.

The Algonquin beach keeps horizontal for about 100 miles farther north than the others in both basins. Then it begins to rise towards the north; for the first fifty miles at a rate of nearly one foot per mile; then for about thirty miles at a rate of a little more than two feet per mile; and then for at least fifty miles and perhaps farther at a rate of more than three and a half feet per mile. The rate of uplift east of Lake Huron seems slightly greater than in the Lakes Michigan and Superior basins. The direction of maximum rise is about north-northeast east of Lake Huron and nearly north in the Lake Michigan Basin.

The Kirkfield outlet of the Algonquin to the Trent Valley in Ontario was discussed and it was shown that the opening of this outlet lowered the level of Lake Algonquin at least 40 or 50 feet, and that at this time the ice sheet had withdrawn from all of the Lake Michigan Basin, from nearly all of the Lake Huron Basin, and probably from much of the Lake Superior Basin. Lake Algonquin was at first confined to the Lake Huron Basin with its outlet at Port Huron. Whether its mergence with Lake Chicago occurred before or after the opening of the Kirkfield outlet is not known. The Kirkfield outlet was in the area of great uplift and was soon carried up to a higher altitude than the old outlet at Port Huron, to which place the discharge was then returned. The uplift then continued, at first slowly, but later with rela-

tive rapidity, producing before its close the remarkable series of northward splitting beaches which are associated with Lake Algonquin.

Following the discussion of the beaches of Lake Algonquin, the Nipissing Great Lakes were described with their outlet eastward through Lake Nipissing to the Ottawa River. Continuing uplift raised this outlet and turned the discharge of the upper lakes back once more to Port Huron, where it has remained to the present time.

The character of the causes of the deformation of the old water planes was discussed very briefly (*a*) with reference to the effects produced on the water planes within the Great Lake area, (*b*) in the light of Pleistocene deformations affecting wider areas, and (*c*) in the light of the leading theories concerning the conditions of matter in the interior of the earth.

The Mississippian Section in Illinois: Stuart Weller, Chicago, Ill.

No detailed studies of the Mississippian rocks of Illinois have been reported for over a generation. In the meantime much progress has been made in the study of the equivalent formations in neighboring states, and much information regarding them has accumulated. In view of these conditions it has seemed desirable to conduct a series of investigations upon these formations in Illinois where the typical sections occur, using the more modern methods of stratigraphy and paleontology. The present paper is a report of progress of these studies which have been carried on during the last two years.

Devonic Elements in the Late Siluric Fauna of Southern Michigan:[3] A. W. Grabau, New York, and W. H. Sherzer, Ypsilanti, Mich. (Read by W. H. Sherzer.)

In southern Michigan the Monroe formation forms the upper part of the Siluric. In the upper part of this formation and about 200 feet below its summit is an intercalated coral-reef limestone 40 to 50 feet thick, made up of Siluric and Devonic stromatoporoids and corals, and containing, besides, a number of other fossils related to species elsewhere in this country known only from the lower Middle Devonic. The highest beds of the region contain an upper Siluric fauna of European affinity. The bearing of these facts on the paleogeography of the Upper Siluric and on faunal development and migration was discussed.

Notes on the Traverse Group of Michigan:[4] A. W. Grabau, New York City. (Read by W. H. Sherzer, Ypsilanti, Mich.)

During the progress of the study of the stratigraphy and faunas of the Traverse Group of northern lower Michigan—a number of distinct faunal divisions have appeared. The subdivisions of the group and the migrations of the successive faunas were considered, and the progressive evolution of some of the characteristic species was traced.

The Evolution and Distribution of the Plesiosaurs: S. W. Williston, Chicago, Ill.

The known range of the Plesiosauria of North America is from the Upper Jura (Baptanodon beds) to the middle or upper part of the Fort Pierre Cretaceous. A comparison of nearly all the known material from North America with much of that from Europe gives assurance that no known genus is certainly common to the two continents. The genus *Plesiosaurus,* especially, the most generalized of the known plesiosaurs, is certainly not represented by any known species in America.

[3] By permission of Dr. A. C. Lane, state geologist of Michigan.

[4] By permission of Dr. A. C. Lane, state geologist of Michigan.

The American forms, moreover, present a higher degree of specialization than is known among the European. As stated by the author in an earlier paper, the plesiosaurs as a group, which at least is of subordinal rank, present sufficiently wide and distinct divergences of structure to warrant their separation into a number of well-marked families, families distinguished by structural characters fully the equivalent of those used in the classification of modern reptiles. Of these families, the author is prepared to define at least three from North America: the Elasmosauridæ, characterized by the greatly elongated neck, absence of interclavicle and interclavicular foramen, and the broad separation of the coracoids posteriorly, especially; the Polycotylidæ, by the presence of a large interpterygoidal foramen anterior to the parasphenoid, large interclavicle and interclavicular foramen, three or four epipodial bones, etc.; the Brachaucheniidæ, by the broad union of the pterygoids anteriorly, the absence of interpterygoidal foramen, very short neck, etc. He believes that at least two other families will have to be erected for the reception of known forms.

On the Discovery of Vertebrate Fossils in the Pennsylvanian, near Pittsburgh, Pa.: PERCY E. RAYMOND, Pittsburgh, Pa.

In the clay which underlies the Ames limestone the writer has found remains of vertebrate fossils. These fossils have been identified by Dr. W. D. Matthew and Professor E. C. Case as belonging to amphibians, theromorph reptiles and pelycosaurian reptiles. As the horizon from which these bones were obtained is in the Conemaugh series about midway between the top of the Mississippian and the base of the Dunkard series (Permian), it seems probable that these are the oldest reptiles yet discovered. It has been suggested that the beds which contain these fossils are of Permian age, but in spite of the affinity of these forms with the Permian species, the preponderance of evidence at the present time is in favor of retaining the Conemaugh series in the Pennsylvanian.

On the Discovery of Pelycosaurian Remains in Rocks of Pennsylvanian Age near Pittsburgh, Pa.: E. C. CASE, Ann Arbor, Mich. (Read by title.)

The Lignite of Mississippi: CALVIN S. BROWN, University Post Office, Mississippi.

This paper described the situation and topography of those portions of Mississippi that are known to be underlain by lignite. The mode of occurrence and geological relationship of the lignite beds were outlined and the character of the material in composition and its value as a combustible were briefly sketched.

The Influence of the Tides on the Earth's Rotation: T. C. CHAMBERLIN, Chicago, Ill.

The ultimate purpose of the study was to determine whether changes in the rate of the earth's rotation have been serious factors in its deformation. The problem may be approached from the astronomic and from the geologic points of view. The former are largely cosmogonic and tidal, and the tidal involve the cosmogonic. The inferences from the older cosmogonies involve gaseous and molten states, as well as the separation of the moon from the earth; and are thus radically different from the inferences drawn from a cosmogonic hypothesis which permits a rigid elastic state of the earth from its beginning. The subject is, therefore, open to reconsideration in the light of alternative hypotheses.

The necessity for treating the tides as the phenomena of essentially independent bodies of water lying in irregular basins on the surface of the lithosphere was shown by

citations from the co-tidal charts recently issued by the U. S. Coast and Geodetic Survey. Attention was called to certain anomalies in the relative heights and peculiar behavior of the tides which render difficult any explanation on the usual lines, and Harris's theory of their essential origin in special segments of the oceans was briefly sketched. In addition to this, an inertia tide, assigned to the tilting of the basins by the tidal deformation of the lithosphere, was suggested as a supplementary possibility, but its quantitative value was not estimated or urged.

The normal oscillations of the earth as a spheroid were briefly discussed in the light of mathematical deductions and of certain seismic, nutational and tidal phenomena, with the general conclusion that the lithospheric pulsations, whether tidal or otherwise, have a short period and, in the case of the tides, act directly with the forcing agency.

An attempt to analyze and estimate the influence of the water tides as a retarding agency by the usual method based on the positions of the tidal protuberances, was found not only impracticable because of its intricacies and theoretical uncertainties, but because it involved an unrecognized factor that renders the method misleading. Moulton has found that all energy which is converted into heat by the friction or impact of the lunar tides and lost by dissipation, must in the present configuration of the earth-moon system be taken from the rotation of the earth and the revolution of the earth-moon system in the proportion of 27:1, and that the rotation of the earth must be reduced and the moon must retire, and that *this is independent of the kind or phase of the tide.* It is, therefore, only necessary to estimate the total loss of energy by the tides and subtract the appropriate portion of this from the rotational energy of the earth to ascertain its retarding effects.

The data for such an estimate were put into a tractable form, with large assumptions of tidal height and frictional zones, and submitted to W. D. MacMillan for computation by the formulas used by engineers. The result gave an increase in the day of one second in 460,000 years, or less than four minutes in 100,000,000 years.

The geological evidences were discussed on the basis of a series of spheroidal deformations corresponding to a series of rates of revolution computed by Slichter. It was found that changes of rotation would cause distinctive kinds of deformation of which no distinct traces could be detected. The distributions of the hydrosphere through the geological ages were also found incompatible with the theory of appreciable change of rotation. These negative evidences of the geological record are in close harmony with the computed effects on the revised basis.

Glacial Erosion in Wales: W. M. Davis, Cambridge, Mass.

The mountains of north Wales are peculiarly significant in the problem of glacial erosion, because they retain in part forms little changed from those which are not producible by normal erosion, but which are eminently characteristic of the forms that glaciers would produce if they acted as eroding agents. In order to appreciate the meaning of these contrasted forms, it is essential that the observer should have in mind a clear picture of the forms appropriate to subdued mountains that have been acted on only by normal agencies. The general absence of such mountains in western Europe has delayed the recognition of the glacial origin of a number of abnormal features.

Beginning and Recession of Saint Anthony's Falls: F. W. SARDESON, Minneapolis, Minn.

The character of the Mississippi gorge from Fort Snelling to St. Anthony's Falls was outlined and a description was given of the terraces and abandoned gorges, to show that the falls have increased in height during their recession. The early history of St. Anthony's Falls was described in detail and the formerly estimated rate of recession of the falls was revised.

Arched Structure in Lockport Limestone: H. L. FAIRCHILD, Rochester, N. Y.

The author exhibited a few lantern views showing arching layers in the Lockport (Niagara) limestone at Niagara Falls. This peculiar structure has been known for seventy years and was figured in Hall's report on the fourth (New York) district, 1843, but no satisfactory explanation of the phenomenon has been found.

Correlation of Distribution of Copper and Diamonds in the Glacial Drift of the Great Lakes Region: OLIVER C. FARRINGTON, Chicago, Ill.

The distribution of copper in the glacial drift south of the Great Lakes resembles closely that of the diamonds which have been discovered in the same region. As the source of the copper is known to be the rocks bordering the shores of Lake Superior, it seems probable that the source of the diamonds was in the same region.

The Alteration of Glacial Deposits by Later Ice-invasions: FRANK CARNEY, Granville, Ohio.

The readvance of an ice-sheet subjects the drift already accumulated to gradation which probably removes much of it, and to differential stresses which presumably alter the portion not removed. The extent of this alteration is influenced (1) by the length of the interval of deglaciation, a control that is further conditioned (*a*) by cementation of the early drift, whether till or modified deposits, and (*b*) by topography; (2) by the thickness or weight of the over-riding ice; (3) by the activity of the ice, especially if at different times the predominant motion varied somewhat in direction. The change brought about in over-ridden drift differs with the nature of the drift: if till, the changes produced are disturbance or distortion, foliation, induration, jointing, faulting, and apparently color-alteration; if modified deposits, distortion, jointing, faulting, but only slight foliation and induration.

The presence of such alteration in drift in proximity to drift bearing no such evidence suggests that the two represent distinct ice-epochs.

A Demonstration of the Curvature of the Earth's Surface: ROBERT M. BROWN, Worcester, Mass.

The paper recorded an observation by the writer on the curvature of the earth at Lake Quinsigamond, near Worcester, Mass. A board two feet square, divided vertically into a black upper surface and a white lower one, was set up with the union of the two surfaces at a certain height above water level. On an island about 4,000 feet away a white bar was erected, parallel to the water and at the height of the horizontal line of the first piece of apparatus. In line with these two and about 4,000 feet beyond the second piece, a telescope was set at the given height above the water. On sighting through the instrument the bar was projected against the top of the board. A scale suspended from the bar showed the amount of deviation from a straight line. From this reading the size of the earth was deduced.[5]

[5] Printed in full in the *National Geographic Magazine*, Vol. XVIII., 1907, 771–774.

Working Hypothesis on the Physiography of Alaska: Wallace W. Atwood, Chicago, Ill.

Associated with the study of the Cretaceous and Tertiary formations in the district of Alaska, it has been necessary to consider with some care the physiographic history of the district. In the coastal provinces there has long been recognized a great peneplain which is now represented by the summits of the Coast ranges. This is shown in southeastern Alaska, along the gulf of Alaska and on the Kenai Peninsula.

In the Controller Bay region and in the Cook Inlet region, distinct peneplains were recognized below the summits of the Coast ranges. In the Cook Inlet region the lower peneplain is post-Kenai (Oligocene) and the upper or summit peneplain, there represented by the crest of the Kenai Peninsula, is certainly pre-Kenai. Through the Kenai Peninsula there are certain passes which correspond in elevation with the general level of the lower peneplain, and which are the valleys developed during the period when the second peneplain was being developed.

In crossing the Coast range at White Pass, the uppermost or summit peneplain is readily recognized, but below this level there is a system of broad open valleys in which White Pass, Chilcoot and Chilcat Pass belong. Passing to the northward and down the head waters of the Yukon system, the uppermost, or summit peneplain, was traceable, but the remnants which reached that level became less and less in extent and in number. At Cariboo, in the Yukon territory, an intermediate bench appears and to the northward many more extensive benches and ridges reach that intermediate level. Before reaching Dawson the intermediate horizon is seen to represent the summit of the Yukon plateau. This plateau has been recognized by many as a great peneplain, and its correlation with the summit peneplain has been suggested. The studies during the past season would indicate that these two great Peneplains are distinct, and suggest, at least, that the broad passes through the Coast ranges are of the same age as the Yukon plateau peneplain.

In the central portion of the great Yukon plateau area between Eagle and Fairbanks, the Yukon plateau is well shown, and rising above it there are many monadnock forms which belong to the earlier or summit peneplain of the Coast ranges. There are also distinct benches below the Yukon plateau, and from 1,200 to 1,400 feet above sea-level, which attract attention. They are represented at Eagle by a low ridge just south of town, and in the valley of Seventy Mile and Mission Creek, by broad open valleys above the present gorges.

Continuing the studies farther down stream, the upper peneplains became less and less conspicuous, and the lower one grew in importance and then took a lesser place, as the modern peneplain, represented by the broad alluvial flats of the lower Yukon, Koyukuk and Kuskokwim rivers became more conspicuous.

The hypothesis stated briefly is that the great summit peneplain of the coastal province is distinct from certain lower peneplains bordering the Pacific and from the Yukon plateau peneplain of the interior; that in the Yukon basin there have been several peneplains developed and that each process of peneplaination has moved as a wave up that basin from the westward, just as the modern peneplain is today moving up that valley; that the extent and number of remnants of each peneplain decrease from the headwaters of the Yukon toward the mouth, just as terrace remnants in a single valley may decrease from their up-stream termini to the lower portion of

the valley; that the lower peneplains of the Pacific coast provinces may possibly be correlated with the Yukon plateau peneplain, or with still lower erosion surfaces in the interior; that Schrader's Koyukuk plateau, just south of the Endicott Mountains, is to be correlated with the 1,200–1,400 foot peneplain recognized in remnants along the Yukon and its tributaries near Eagle, and by more extensive areas farther down the valley; that the summit peneplain of the Rocky Mountains described by Schrader may be of the same age as the summit peneplain of the Coast ranges.

The Honeoye-Irondequoit Kame-Moraine: CHARLES R. DRYER, Terre Haute, Indiana.

The range of drift hills described extends about fourteen miles in the counties of Livingston, Monroe, and Ontario, N. Y. It is divided by transverse valleys into three principal portions. (1) The Irondequoit-Turk Hill portion consists of heavy Kame deposits in the Irondequoit Valley, which, extending eastward over the Turk Hills, appear to be a group of large drumloids, partly buried and masked by sands and gravel. (2) The Gahyandock Hills consist of massive Kame deposits, superposed upon a basal terminal moraine, the surface of which is exposed in the bordering plateaus. These hills rise to 1,100 feet A. T. (3) The Bloomfield-Lima Kame-moraine adjoins (2) on the south, and consists of a gravel outwash plain on the north, changing to a typical terminal moraine at the southern end.

The range is cut through by the present valley of Honeoye Creek at its southern end, where well borings show the presence of a deeply drift filled preglacial valley. (1) and (2) are separated by the Rush-Victor glacial river valley which was a line of eastward drainage for melting ice and subsequent lake waters. The filled valley of the lower Irondequoit has a rock bottom below the level of Lake Ontario and is thought to have been the preglacial outlet of the Honeoye Valley. The whole range was a continuous marginal deposit during the retreat of the Wisconsin ice sheet and marks the position of the debouchment of a powerful subglacial stream.

Glacial Lake Bloomfield: CHARLES R. DRYER, Terre Haute, Indiana.

Numerous deltas in the Honeoye and Hemlock Valleys in Ontario and Livingston Counties, N. Y., at the 1,000-foot level A. T., indicate the existence of an ice-dammed lake which succeeded the glacial Honeoye and Hemlock Lakes described by Fairchild, and immediately preceding Lake Warren. Its principal outlet was across the divide eastward to the Bristol Valley. A later and lesser outlet was opened to the northeast near the village of East Bloomfield. Two smaller spillways to the west may have been briefly active. The northern border of Lake Bloomfield was formed by the margin of the ice, when it stretched from the Gahyandock Hills to the north end of a ridge three miles west of Lima Village.

The Loesses of the Mississippi Valley: B. SHIMEK, Iowa City, Iowa.

Evidence was presented to the effect that a loess deposit followed each drift sheet, and that the loesses are inter- and post-glacial. This conclusion is supported by the vertical position of the loesses with reference to the drift-sheets; by geographical position, the best illustrations occurring near the borders of drift-sheets; by root-tubes; by fossils; by differences in texture and composition.

The Gases in Rocks: R. T. CHAMBERLIN, Chicago, Ill. (Read by T. C. Chamberlin.)

Some of the results of 112 analyses of the gases derived from a wide range of

rocks, and a part of the generalizations based upon these were presented. A classification of the analyses according to the types of igneous rocks brought out the fact that, while the rocks of each group may vary considerably among themselves, the group as a whole fits into a logical place in relation to the other groups. Arranged in the order of the total volumes of gas evolved per unit volume of rock, the types of rock rank thus: (1) Basic schists, (2) diabases and basalts, (3) gabbros and diorites, (4) granites and gneisses, (5) andesites, (6) syenites, (7) rhyolites.

A classification on the basis of the age of the rocks showed a rapid and steady decline in the quantity of every gas in passing up the columns from Archean to Recent lavas. Fine-grained rocks were found to give off more gas than those of coarser granularity.

A series of special experiments showed that the gases obtained from heating rock material in vacuo come from three sources: (1) Gas held mechanically in minute cavities and pores, (2) gas occluded within the substance of the rock, and (3) gas produced by chemical interaction between the non-gaseous constituents of the rocks at the high temperatures used.

An average of 51 analyses of the gas from igneous rocks, expressed in volumes of each gas per unit volume of rock, gives the following figures: H_2S, .01; CO_2, 2.16; CO, .18; CH_4, .05; H_2, 1.36; N_2, .09; and total, 3.85.

It was found that rock powders which had ceased to give off gas in combustion tube, and were apparently exhausted of their gas content, were able, when re-heated after an interval of several months, to produce a considerable quantity of additional gas amounting, in some cases, to as much as half the volume originally obtained. Test experiments showed that this was not the result of a selective absorption of gases from the atmosphere during the interval, but was due to some kind of diffusion or molecular rearrangement going on slowly within the rock material.

The significance of these gases, existing in a threefold state so generally and in so large a variety of rocks, and their bearings on some of the problems of vulcanism and of the atmosphere were indicated.

In the discussion that followed the reading of this paper reference was made to the bearing of the results upon the explanation of causes of gas explosions in mines. Dr. A. J. Holmes, chief of the technical branch of the U. S. Geological Survey, in the course of his remarks on the subject, gave a report of progress of the investigations undertaken by the survey to establish the cause of the recent disastrous explosions in coal mines.

Work of the United States Reclamation Service: E. T. Perkins, Chicago, Illinois.

This paper was a summary of the results obtained by irrigation in the United States and other countries, and a statement of the work being done by the U. S. Reclamation Service.

Fjords of Puget Sound and the Saguenay: Warren Upham, St. Paul, Minn.

This paper presented the results of the study of the Puget Sound and the Saguenay regions.

Puget Sound and its many long and narrow arms, called canals, from 100 to 600 feet in depth beneath the sea level, are admirable examples of fjords opening northward, running thus toward the interior of the ice-sheet which during the glacial period covered this district, being the southern part of the continental ice-sheet west of the Rocky Mountains. It is impossible to ascribe the depth of these fjords to glacial erosion because they run in courses opposed to the courses of glacial erosion and transportation of material eroded.

The Saguenay Fjord, sixty miles long, river-like in its nearly uniform width and its somewhat winding course, with a depth from nearly 500 to 900 feet beneath the sea level, continuously enclosed on each side by steep or precipitous bluffs and cliffs 500 to 1,500 feet high, is regarded as a very typical fjord of the Norwegian type.

Both the fjords of Puget Sound and of the Saguenay have been eroded alike by river channeling before the Ice Age, showing, with the other fjords farther north, that this continent was greatly uplifted during a considerable time preceding the continental glaciation. Such high land elevation the author believes to have caused the cold climate and the accumulation of snow and ice which characterized the Glacial Period.

W. S. BAYLEY,
Secretary pro tem.

THE HANOVER MEETING

Section E, Geology and Geography, proposes to give a series of excursions to various points in Vermont and New Hampshire in connection with the meeting of the American Association for the Advancement of Science at Hanover this summer.

A tentative plan is the following:

1. The first excursion to be under Dr. Wolff, of Harvard University, starting from Bellows Falls, Vt., Friday, June 26. This will be a trip across the Green Mountains, arriving at Rutland, Vt., some time on Saturday.

2. An excursion with Professor G. H. Perkins, state geologist of Vermont, to some of the marble quarries.

3. An excursion to Ascutney Mountain, Vermont, under Dr. R. A. Daly.

4. A trip to the Quechee River local glacier under Professor Hitchcock, of Dartmouth.

5. A study of the terraces of the Connecticut River.

6. A day in the Corbin Park to see the buffaloes, etc.

7. A trip of one to three days around Littleton, N. H.

8. A trip to Mt. Monadnock, if enough care to go.

9. A trip to one of the points of interest for economic geology.

10. The final excursion will be made to the Summit House on Mt. Washington, where greatly reduced rates have been secured for a stay of from a day to a week.

It will greatly assist in making arrangements for the meeting if all those who have any thought of taking part in these excursions will send word as soon as possible to

F. P. GULLIVER,
Secretary Section E
30 HUNTINGTON LANE,
NORWICH, CONN.

A PLAN FOR AN EXCHANGE OF TEACHERS BETWEEN PRUSSIA AND THE UNITED STATES[1]

ON behalf of the Department of Ecclesiastical Affairs, Instruction and Medical Affairs of Prussia, Geheimer Ober-Regierungsrat, Dr. Karl Reinhardt, addressed the Carnegie Foundation for the Advancement of Teaching in the summer of 1907 and laid before it a plan for an exchange of teachers between Prussia and the United States. An exchange similar to the one proposed is now in effect between Prussia on the one side, and France and England on the other; and in view of the usefulness of this work, not only in the school systems of the respective countries, but also in the better feeling and understanding of the countries, Dr. Reinhardt urged the exten-

[1] Bulletin issued by the Carnegie Foundation for the Advancement of Teaching. The committee of arrangements consists of Dr. Henry S. Pritchett, president of the foundation, Professors Julius Sachs and Calvin Thomas, Columbia University, and Headmaster James G. Croswell, Brearley School, New York.